MODEL 1412B

LIMITS COMPARATOR

Instruction Manual

Part Number 42428 January 1980

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esi Manual

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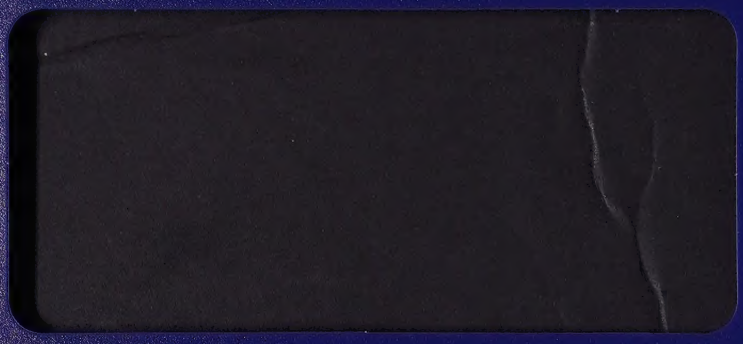

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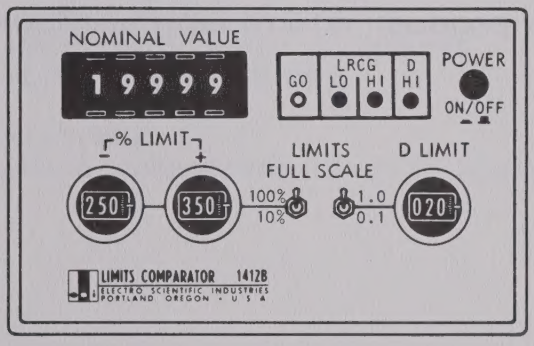

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SECTION 1
DESCRIPTION

1.1 INTRODUCTION

ESI Model 1412B Limits Comparator is designed as a companion unit to the Model 251, 252, 253, 254, 275, 278, 475, or similar Digital Meter with analog output. The combination of Model 1412B and 252, 253, 254, 275, 278 or 475 allows capacitors to be sorted by percent deviation and dissipation factor simultaneously. When used with Model 251, percent deviation sorting on any of its four functions (L, R, C, and G) can be done.

Controls on the Model 1412B front panel set nominal value, deviation upper and lower limits plus dissipation factor upper limit. Rear panel connections include four relays which close individually when a related limit is reached. In the gated mode, a comparison is initiated by a control switch and held for an adjustable time up to two seconds after release of the switch.

1.2 SPECIFICATIONS

Nominal LRCG: 00500 to 19999 (Setting corresponds to nominal reading on companion unit's digital panel meter. Model 1412B assumes the decimal point is in the same position as on the companion display.)

% Limits: Independently set for + and -. Range, 0 to 100.0% or 0 to 10.00%, selected by a toggle switch.

D Limit: Sets upper dissipation factor limit. Range, 0 to 1.000 or 0 to 0.1000, selected by a toggle switch.

Accuracy:

Nominal Value*	±0.1% of reading (01999 to 19999)
	±0.3% of reading (00500 to 01999)
LRCG Limits	±0.5% of full scale
D Limit	±0.5% of full scale

*Assumes Model 1412B is trimmed to match Model 275 or 278 output on the 200nF range or equivalent on companion unit (see Section 3.1). System accuracy will be the sum of the separate % tolerances of Model 1412B and Model 275/278 or equivalent companion unit (±0.2% of nominal for most ranges).

Relay Contacts (Rear Panel Connections): Four isolated relays close individually in synchronism with front panel lamp indications.

Relay Contacts Ratings: 28VDC, 100mA; 1ms switch closure time.

Gated Relay Closure: Gated mode operation may be selected by means of a rear panel switch. In this condition the relay contacts remain open and indicators remain off when a limit is reached, unless closure is initiated by a control switch. Duration of closure, after the control switch is released, is determined by the adjustment of the UNLATCH DELAY control (two seconds maximum).

Input Signals (From Model 251, 252, 253, 254, 275, 278 or 475): L, R, C or G analog output; D analog output; reference voltage output (except 251) and analog common. When used with ESI Model 251, 252, 253, or 254 the rear panel V REF switch must be in INTERNAL position.

Dimensions: Height 13.5cm (5.3 in) with feet, width 21.6cm (8.5 in), depth 33cm (13 in) overall.

Weight: 3.63kg (8 lb) net.

Power: 115V or 230V ±15%, 50/60Hz, 10W.

SECTION 2

OPERATION

2.1 FRONT PANEL CONTROLS AND INDICATORS

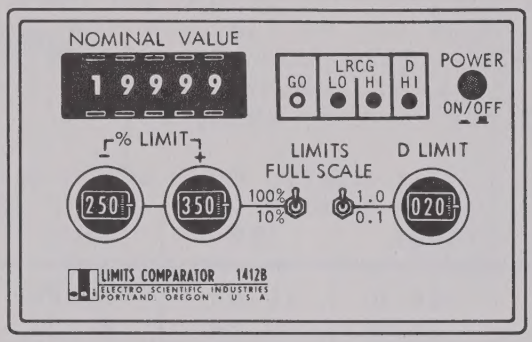


Figure 2-1. Model 1412B Front Panel

NOMINAL VALUE

The nominal value is set on these switches.* Setting corresponds to nominal reading on digital panel meter of companion unit, except it does not show the decimal point. Normally, the range is selected to give a nominal value setting greater than Ø1990. See Table 2-1 for examples.

Nominal Capacitance Value	Model 275/278 RANGE Switch Position	Model 275/278 Panel Meter Expected Reading	Model 1412B NOMINAL VALUE Switch Setting
2.5ØnF	2ØnF	2.5Ø	Ø25ØØ
17.5 nF	2ØnF	17.5Ø	175ØØ
159.5 nF	2ØØnF	159.5	159Ø5
5.ØØµF	2ØµF	5.ØØ	Ø5ØØØ

Table 2-1. Examples of Model 1412B NOMINAL VALUE Switch Setting

% LIMITS

These two controls set the upper and lower LRCG limits independently, as a percent of the nominal value. See Table 2-2.

*When Model 275/278 is in Cp mode, the D output to the comparator is not valid. If Cp deviation measurements using Model 1412B are desired, the D LIMIT dial must be set to its maximum, (1)ØØØ, and LIMITS FULL SCALE toggle switch to 1.Ø.

LIMITS FULL SCALE

These toggle switches select the range of the % LIMITS controls (10% or 100% full scale) and of the D LIMIT control (0.1 or 1.0 full scale). For example, in the 100% position, the highest setting (full scale) of the % LIMITS controls is 100.0%.

Figure 2-1 shows the LIMITS FULL SCALE switches in the 100% and 1.0 positions, - % LIMITS dial set to 250, + % LIMITS dial set to 350, and D LIMIT dial set to 020. This means the lower limit is set to 25.0% and upper limit to 35.0% of nominal value. The D limit is set to 0.020. See Table 2-2 for further examples.

LIMITS Dial Setting	LIMITS FULL SCALE Setting			
	% Limits		D Limits	
	100%	10%	1.0	0.1
(1)000	100.0	10.00	1.000	0.1000
750	75.0	7.50	0.750	0.0750
125	12.5	1.25	0.125	0.0125
040	04.0	0.40	0.040	0.0040
025	02.5	0.25	0.025	0.0025
000	00.0	0.00	0.000	0.0000

Table 2-2. Examples of Full Scale Limits Values

D LIMIT

This control sets the upper dissipation factor limit. See Table 2-2.

INDICATORS

GO Indicates value between - and + % limits and less than D limit.
LO Indicates value less than - % limit.
HI Indicates value greater than + % limit.
D HI Indicates dissipation factor greater than limit.

POWER ON/OFF

This push-on, push-off button controls ac line power to Model 1412B.

2.2 REAR PANEL CONTROLS AND CONNECTORS

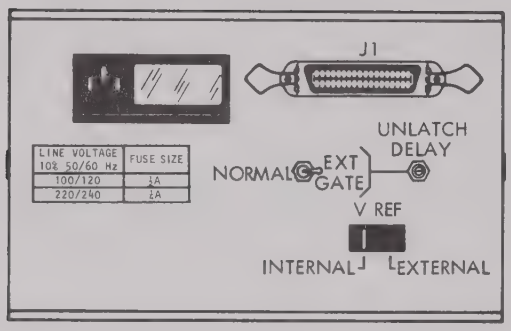


Figure 2-2. Model 1412B Rear Panel

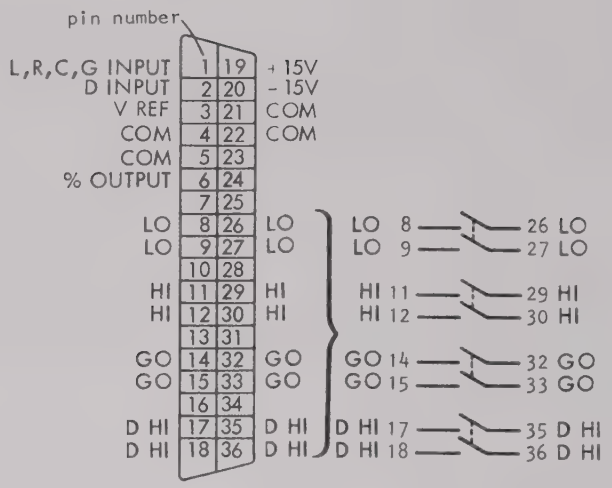
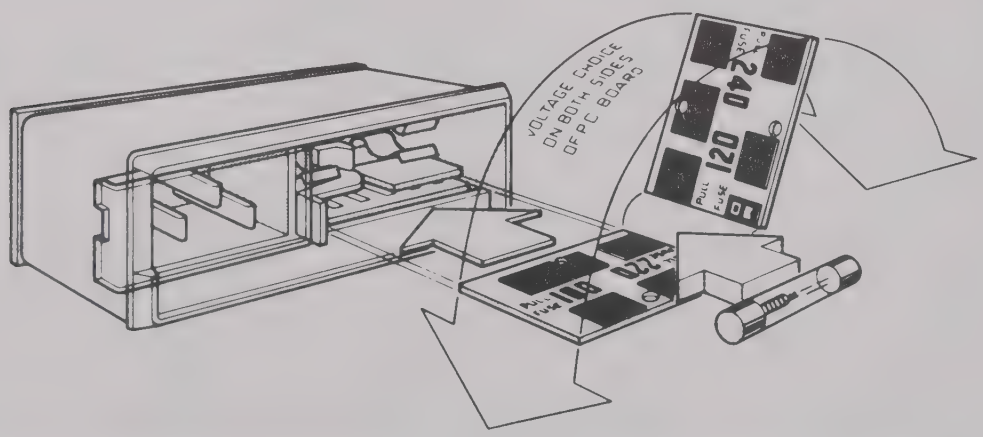


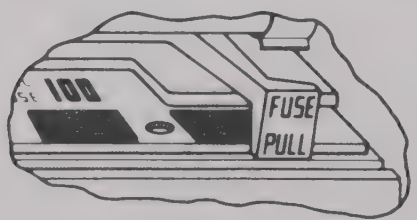
Figure 2-3. Connector J1 Pin Assignments

LINE VOLTAGE SELECTION

Input voltage selected for Model 1412B must match the line voltage available. The line cord connector has provision for changing line voltage, as shown in Figure 2-4.



Operating voltage is shown in module window.



SELECTION OF OPERATING VOLTAGE

1. Open cover door and rotate fuse-pull to left.
2. Select operating voltage by orienting PC board to position desired voltage on top-left side. Push board firmly into module slot.
3. Rotate fuse-pull back into normal position and re-insert fuse in holders, using caution to select correct fuse value.

Figure 2-4. Line Voltage Selection

NORMAL/EXT GATE

In the NORMAL position, the comparator makes continuous comparisons of the input signal. In the EXT GATE mode, comparison is initiated by an external switch closure and held closed for an adjustable time, up to approximately two seconds, after release of the switch. The external switch should be connected between connector pin 7 and common (pin 22).

UNLATCH DELAY

When in the EXT GATE mode, this control sets the delay time between the end of the gate and the release of the relay contacts and indicator light.

CONNECTOR J1

This connector carries all input and output signals. See Figures 2-3 and 3-3.

V REF Switch

V REF switch selects between internal and external reference voltage. Models 275, 278, 475, and 478 have reference voltages which Model 1412B can use for reference; the V REF switch should be set to EXTERNAL for these instruments. Other instruments, Model 251, 252, 253, 254 for example, do not have a reference voltage that can be used by Model 1412B. The INTERNAL position should be used for instruments of that type.

2.3 OPERATING INSTRUCTIONS

2.3.1 Connection to Companion Units

Two cables are supplied with Model 1412B. One has a 36-pin connector at each end (P/N 26668). It is designed for connection to Model 275 or 278 or to a Model 475. The other cable has a 36-pin connector on one end and a spade lug, banana plug pair at the other (P/N 42855). Instruments with analog outputs on barrier strips or banana jacks use this cable.

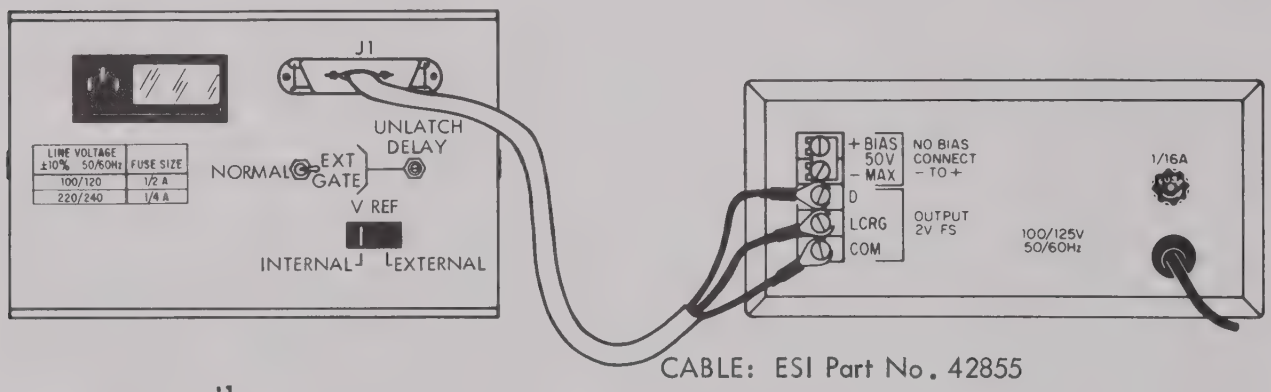
Interconnection to Model 251

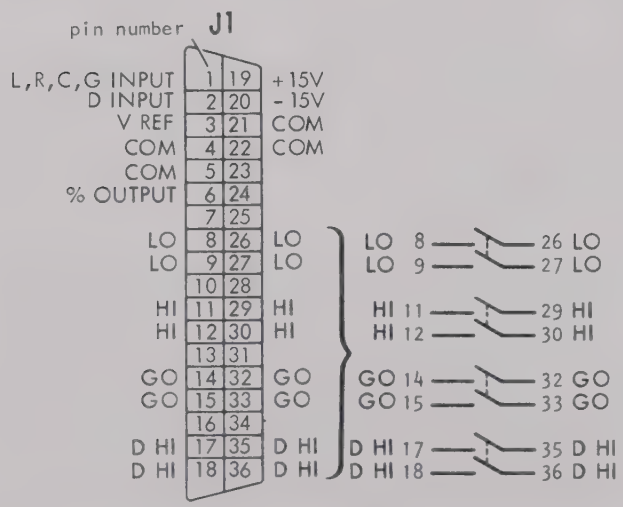
Select the cable with a 36-pin connector and banana plugs (P/N 42855). Plug the 36-pin connector into Model 1412B. Observe the polarity tab on the banana plug (tab is on ground side) and plug it into Model 251 OUTPUT terminals on the rear panel, matching polarity. Set Model 1412B V REF switch to INTERNAL before operating.

Interconnection to Model 252, 253, 254

Use cable assembly ESI Part No. 42855 to connect the Model 1412B to the Model 252, 253, 254. Plug the 36-pin connector into the Model 1412B's rear panel connector. Observing correct polarity, connect the spade lugs onto the Model 252, 253, 254's rear panel barrier strip (see Figure 2-5). Set Model 1412B V REF switch to INTERNAL before operating.

Connect the 252, 253, 254 and 1412B as shown in Figure 2-15.




pin number J1
L,R,C,G INPUT 1 19 +15V
D INPUT 2 20 -15V
V REF 3 21 COM
COM 4 22 COM
COM 5 23
% OUTPUT 6 24
7 25
LO 8 26 LO
LO 9 27 LO
10 28
HI 11 29 HI
HI 12 30 HI
13 31
GO 14 32 GO
GO 15 33 GO
16 34
D HI 17 35 D HI
D HI 18 36 D HI
LO 8 — 26 LO
LO 9 — 27 LO
HI 11 — 29 HI
HI 12 — 30 HI
GO 14 — 32 GO
GO 15 — 33 GO
D HI 17 — 35 D HI
D HI 18 — 36 D HI

NOTE: For resistive unknowns connect the D lead to the COM terminal

Figure 2-5. Model 252, 253, 254 and Model 1412B Interconnection

Interconnection to Model 275/278

Select the cable with two 36-pin connectors and plug one end into Model 1412B. Plug the other end into the companion Model 275 or 278.

Interconnection to Model 475

The same cable is used to connect the Model 475 as for Model 275. Early Model 475 units have one rear panel 36-pin connector for connection to Model 1412B. Later units have two connectors, marked C METER and D METER. The connector marked C METER should be used for connecting Model 1412B.

2.3.2 Operation with Model 251

Connect the two instruments together and turn them on.

1. Select desired function and appropriate range on Model 251 to give maximum number of digits on panel meter. Set Model 1412B V REF switch to INTERNAL.

2. Set Model 1412B NOMINAL VALUE switches to anticipated value.

3. Set LIMITS FULL SCALE toggle switches and % LIMITS dials to desired limits. (D LIMIT dials are not used.)

4. Connect unknown to Model 251. If the unknown is within the set limits, GO lamp will light. If it is not within limits, the appropriate indicator will light.

Refer to example in section 2.3.4 for example of similar operation.

2.3.3 Operation with Model 252, 253 and 254

The following instructions assume Model 252, 253, 254 and Model 1412B are connected and both are turned on.

Model 252, 253, 254 setup: (for capacitor sorting)

1. Push the C button on the Model 252, 253, 254 front panel.

2. Set the range switch to give maximum resolution on the display.

Model 1412B setup:

1. Set the rear panel VREF switch to INTERNAL.

2. Set NOMINAL VALUE switches to anticipated value.

3. Set LIMITS FULL SCALE toggle switches, and % LIMITS and D LIMIT dials to desired limits.

The measurement:

Connect the unknown and observe indicator lights. If the LO LED is lit, the unknown is lower than the lower % limit. Similarly, if the HI LED is lit, the unknown is a larger value than the upper % limit. If the D HI LED is lit, the dissipation factor of the unknown exceeds the set limit. If the GO indicator is lit, the unknown value is within the desired limits.

2.3.4 Operation with Model 275 or 278

The following instructions assume Model 1412B is connected to a companion Model 275 or 278 through connector J-1, and both units are turned on.

1. Push Cs button and select the appropriate range on Model 275 or 278 to give maximum number of digits on panel meter. Set Model 1412B V REF switch to EXTERNAL.

2. Set Model 1412B NOMINAL VALUE switches to expected value.

3. Set LIMITS FULL SCALE toggle switches and % LIMITS and D LIMIT dials to desired limits.

4. Connect unknown capacitor to Model 275 or 278. If the unknown is within the set limits, GO lamp will light. If it is not within limits, the appropriate indicator will light.

5. Disconnect unknown and proceed to the next capacitor to be tested.

For example, assume a value of 15μF, +25%, -15% with dissipation limit of Ø.Ø25Ø is desired. The dials should be set as follows:

Model 275/278 RANGE, Function Switches: 2ØμF, Cs
NOMINAL VALUE Dials: 15ØØØ
+ % LIMITS Dial: 25Ø
- % LIMITS Dial: 15Ø
D LIMITS Dial: 25Ø
LIMITS FULL SCALE Toggle Switches: 1ØØ%, Ø.1

Connect the unknown and observe indicator lights. If the LO lamp is lit, the unknown is lower than the lower % limit. Similarly, if the HI lamp is lit, the unknown is higher in value than the upper % limit. If the D HI lamp is lit, the dissipation factor of the unknown exceeds the set limit. If the GO indicator is lit, the unknown value is within the desired limits; in this example, 15$_{\mu}$F, +25%, -15%, with a dissipation factor less than Ø.Ø25Ø.

2.3.5 Operation with Model 475

Operation with Model 475 is very similar to operation with Model 275. The only difference arises from the difference in controls on Model 475. Follow the same procedure for operating Model 1412B with both instruments.

SECTION 3
MAINTENANCE

3.1 ALIGNMENT PROCEDURE

Model 1412B must be aligned with the companion unit to achieve maximum accuracy. The companion unit should be calibrated before aligning Model 1412B. The following procedure describes alignment with Model 252, 253, 254, 275, or 278.

Also refer to Alternate Alignment Procedure, Section 3.2.

3.1.1 Equipment Required

Digital Volt Meter - Resolution 100μVDC

Standard Capacitors - 1000pF ±0.2%
100nF ±0.05% with D<0.0002

3.1.2 NOMINAL VALUE Alignment

1. Connect the Model 1412B to the companion Model 252, 253, 254, 275, or 278. Plug in and turn on both instruments. Remove the top cover from the Model 1412B.

2. Connect the capacitance meter leads to the 1000pF capacitor. Set the capacitance meter to Cs and 200nF RANGE. Set the 1412B as follows:

NOMINAL VALUE	00100
- and + % LIMITS	100
D LIMIT	100
LIMITS FULL SCALE Switches	10% and 0.1
NORMAL/EXT GATE Switch	NORMAL
V REF Switch	EXTERNAL (INTERNAL with 252, 253, 254)

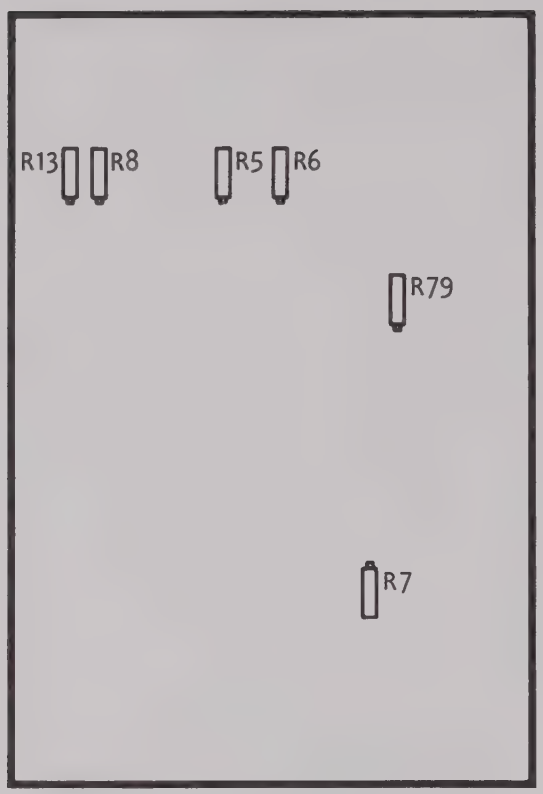


Figure 3-1. Model 1412B Trimmer Locations

3. Connect the DVM low lead to the input connector pin 5 (or the guard stripe on the circuit board) and the high lead to pin 6 (or terminal J1-6 on the circuit board).

4. Adjust R13 on the circuit board (see Figure 3-1) for ØV ±Ø.Ø5V.

5. Connect the capacitance meter leads to the 1ØØnF capacitor and set Model 1412B NOMINAL VALUE to 1ØØØØ.

6. Adjust R8 on the circuit board (see Figure 3-1) for ØV ±Ø.ØØ2V.

7. Steps 4 and 6 interact; reconnect the 1ØØØ pF capacitor and repeat steps 4, 5, and 6 as necessary.

8. Repeat step 5 except set the V REF switch (rear panel) to INTERNAL.

9. Adjust R79 on the circuit board (see Figure 3-1) for ØV ±Ø.ØØ2V.

3.1.3 LIMITS Dial Scale Alignment

1. Connect the 100nF capacitor and set the controls as follows:

Capacitance Meter RANGE	200nF
Capacitance Meter Mode	Cs
LIMITS FULL SCALE Switches	100% and 0.1
NORMAL/EXT GATE Switch	NORMAL
V REF Switch	EXTERNAL (INTERNAL with 252, 253, 254)

2. Set the NOMINAL VALUE switches and LIMITS dials per table below and adjust trimmers R5, R7, and R6 (see Figure 3-1) for the corresponding limit lamp on/off crossing.

Nominal Value	Adjust	Dial*	Dial Setting	Lamp
10100	R5	-%	010±002	LO
9900	R7	+%	010±002	HI
10000	R6	D	002±002	D HI

Table 3-1. Limits Dial Scale Alignment

3.2 ALTERNATE ALIGNMENT PROCEDURE

Normally, adjustment of R8 on the Model 1412B circuit board as explained in the Model 1412B Alignment Procedure will align the unit with its companion unit with no difficulty. However, if zero volts at J1 pin 6 cannot be achieved as called for in Section 3.1.2, perform the following alternate steps.

1. Proceed through step 5, Section 3.1.2 of the Model 1412B procedure, then set R8 on the 1412B circuit board to its physical/electrical midrange.

2. Adjust R58 on the capacitance meter (275, 278 or 475) circuit board for the lowest possible reading on the DVM (while still connected to the 1412B).

3. Adjust R8 on the 1412B circuit board for 0V ±0.002V.

4. With the 100nF standard capacitor still connected to the terminals of the companion unit, adjust the full scale trimmer of the digital panel meter for a reading matching the standard.

5. Repeat the entire alignment procedure for the Model 1412B per Sections 3.1.2 and 3.1.3.

*Other dials need not be set to any specific value

3.3 PARTS LIST

3.3.1 Mainframe

Circuit No.	Description	ESI Part No.
DS1, DS2, DS4	Lamp, LED, OSL-3L, Red	336-26021
DS3	Lamp, LED, OSL-16L-2, Green	336-26663
F1	Fuse, 1/2A	333-01802
FL1	Filter, Receptacle, Fused	504-40002
J1	Connector, 36 Pin	504-15739
R24-R26	Potentiometer, 10kΩ, 10 Turn	306-26024
R43	Potentiometer, 1MΩ, 1 Turn	306-26023
R82	Resistor, 470Ω, 10%, 1/4w	307-13915
S1	Switch, ON/OFF	330-23164
S2	Switch, V REF	330-20393
S3, S4	Switch, SPDT	330-18769
S5	Switch, 4 Pole Thumbwheel	330-27845
S6	Switch, DPDT	330-26025
T1	Transformer	340-20135
U1, U2	Regulator, 15V	343-27816
	Cable Assembly, 275 to 1412B	520-26668
	Cable Assembly, 251 to 1412B	520-42855
	Heat Sink, for U1, U2	329-41440
	Mounting Clip, LED	329-18628
	Power Cord	520-24077
	Front Panel	709-41998
	Back Panel	709-41995
	Side Panel	711-26030
	Top Cover	711-26032
	Bottom Cover	711-26033
	Bezel	710-21900
	Bail	436-13174
	Feet	436-08739
	Circuit Board Assembly, Limits Comparator	505-41997

3.3.2 Limits Comparator Circuit Board Assembly (ESI Part No. 505-41997)

Circuit No.	Description	ESI Part No.
C1, C2	Capacitor, 500μF, 50V, Electrolytic	314-01942
C3, C4, C7, C8, C33	Capacitor, 1μF, 35V, Tantalum	314-06472
C5, C6	Capacitor, 0.22μF, 200V	313-12238
C9	Capacitor, 6.8μF, 35V, Tantalum	314-25339
C10	Capacitor, 0.1μF, Mylar	313-06470
C11	Capacitor, 1μF, 200V	313-18843
C12	Capacitor, 0.005μF, 100V, Disk	311-12143
C16, C19-C32	Capacitor, 0.01μF, 100V, Disk	311-12144
C17, C18	Capacitor, 0.001μF, Ceramic Disk	311-21215
CR1, CR2	Rectifier, Bridge, KBP-02	321-21236
CR3-CR14	Diode, 1N914A	321-12356
CR15-CR18	Diode, Zener, 1N4735, 6.2V	321-12079
CR19	Diode, Zener, 1N825, 6.2V	321-20868
K1-K4	Relay, GB822A-2	332-26667
Q1-Q5	Transistor, 2N3904	321-18751
Q6	FET, 2N5462	321-20143
R1-R4	Resistor, 15kΩ, 1/4W, 10%	307-13935
R5-R7, R13	Potentiometer, 10kΩ, 10 Turn	306-20145
R8	Potentiometer, 200Ω, 10 Turn	306-12083
R9	Resistor, 27kΩ, 0.02%	240-26640
R10, R54	Resistor, 5kΩ, 0.02%	240-26641
R11	Resistor, 2.5kΩ, 0.02%	240-26642
R12, R53	Resistor, 4kΩ, 0.02%	240-26648
R14	Resistor, 8.75kΩ, 0.02%	240-26638
R15, R16	Resistor, 1kΩ, 0.02%	240-26643
R17	Resistor, 500Ω, 0.02%	240-26644
R18, R19, R55	Resistor, 10kΩ, 0.02%	240-26645
R20, R51	Resistor, 2kΩ, 0.02%	240-26646
R22, R38-R40	Resistor, 1kΩ, 10%, 1/4W	307-13920
R27-R31	Resistor, 4.7kΩ, 10%, 1/4W	307-13927
R32-R34	Resistor, 470Ω, 10%, 1/4W	307-13915
R35-R37	Resistor, 1MΩ, 10%, 1/4W	307-13960
R41	Resistor, 10kΩ, 10%, 1/4W	307-13933
R42	Resistor, 33kΩ, 10%, 1/4W	307-13939
R44-R46	Resistor, 330Ω, 10%, 1/4W	304-02025
R47	Resistor, 470Ω, Optional	307-13915
R48	Potentiometer, 500Ω, 10 Turn	306-12093
R50	Resistor, 12kΩ, 0.002%	240-42408
R52, R56	Resistor, 20kΩ, 0.02%	240-26647
R57	Resistor, 40kΩ, 0.02%	240-26649
R58-R60, R64-R66, R71	Resistor, 100kΩ, 0.1%, Metal Film	305-26664
R61-R63, R67-R69, R72	Resistor, 200kΩ, 0.1%, Metal Film	305-26665
R70	Resistor, 49.9kΩ, 1%, Metal Film	305-21747
R73	Resistor, 402kΩ, 1%, Metal Film	305-21756
R74	Resistor, 9.09kΩ, 1%, Metal Film	305-22858
R75	Resistor, 100Ω, 1%, Metal Film	305-21720

Circuit No.	Description	ESI Part No.
R76, R77	Resistor, 10kΩ, 1%, Metal Film	305-21740
R78	Resistor, 4.99kΩ, 1%, Metal Film	305-21737
R79	Potentiometer, 1kΩ	306-18469
R81	Resistor, 1.05kΩ, 1%, Metal Film	305-21770
U3-U8, U15, U17	Operational Amplifier, 741C	343-20668
U9-U13	Integrated Circuit, MC 672	343-20633
U14, U16	Operational Amplifier, 741K	353-21625
	Circuit Board, Limits Comparator	505-41996

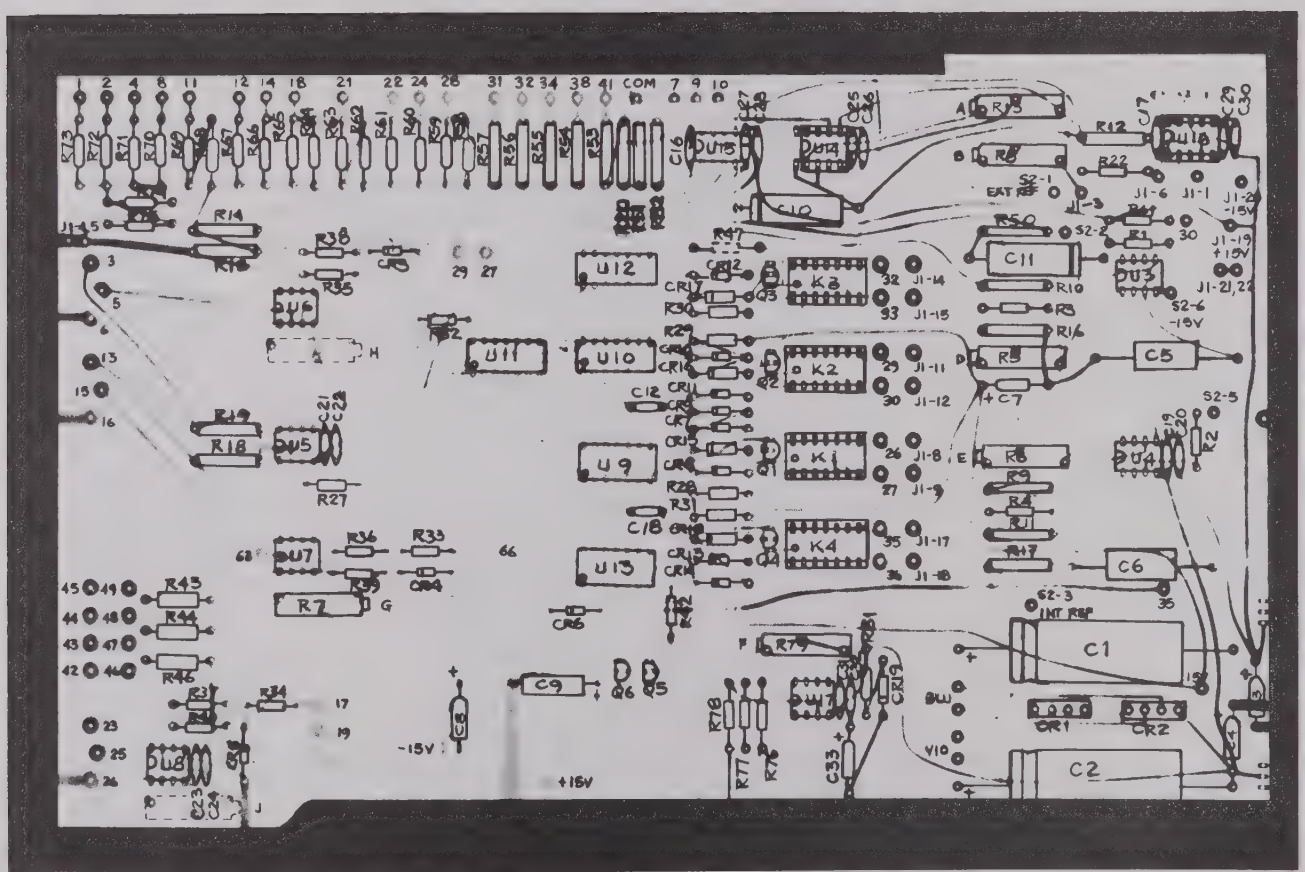


Figure 3-3. Model 1412B Circuit Board Components Locations

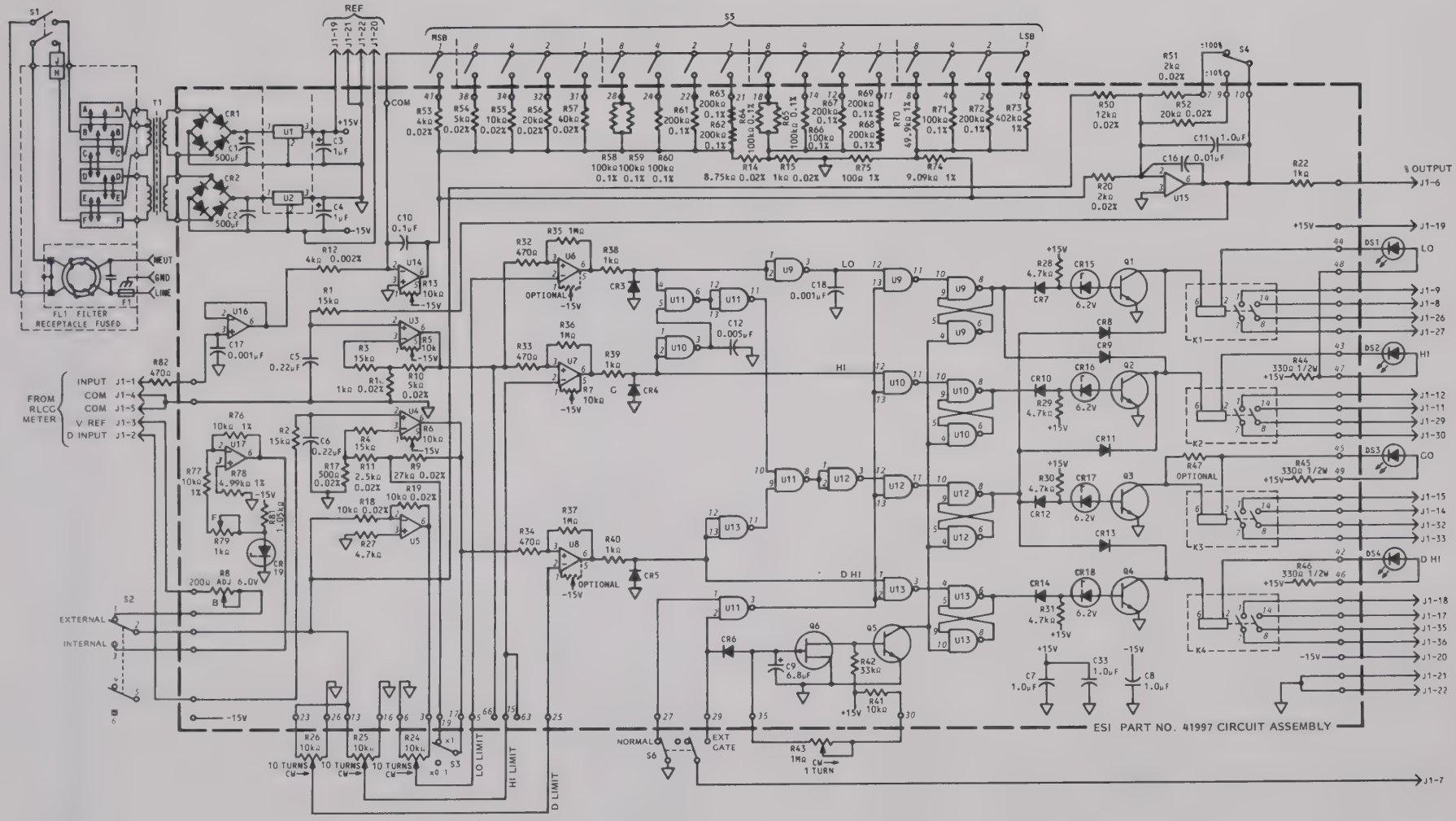


Figure 3-4. Model 1412B Schematic

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   If NO, what would you add _____
   _____
6. Did the organization of the manual help you locate the information you needed? ☐ YES ☐ NO
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